1 Program Overview

The Industrial Technologies Program (ITP) leads the national effort to reduce energy use and carbon emissions in industry. To carry out our mission of transforming the way U.S. industry uses energy, ITP develops and promotes new technologies and practices that improve industrial energy efficiency both today and tomorrow. To this end, we support cost-shared research and development (R&D) to address the top energy challenges facing industry while fostering the adoption of today's advanced technologies and best energy management practices. We want energy-efficient technology to be the first choice when industry replaces equipment or constructs new facilities. To achieve this, the Program:

- Conducts R&D on efficient new technologies
- Promotes distributed generation and fuel and feedstock flexibility
- Supports the commercialization of emerging technologies
- Helps plants access and use proven technologies, energy assessments, software tools, and other resources
- Promotes a culture of energy efficiency and carbon management in industry

ITP's Vision

U.S. industry leads the world in energy efficiency and productivity

"25 in 10" Goal for Industry

Achieving a 25% reduction in industrial energy intensity by 2017 will save an amount of energy equal to that consumed in California (all sectors)—8.4 quads each year.

At its most basic level, this strategy seeks to condition the market, invest strategically in technology R&D, and deliver highly efficient technologies and practices to a receptive industrial stakeholder base.

In line with our mission and vision, ITP has embraced an overarching goal of driving a 25% reduction in industrial energy intensity by 2017, in accord with the Energy Policy Act of 2005. This Save Energy Now "25 in 10" initiative delivers resources to help *all* companies improve their energy performance, no matter where they lie on the efficiency continuum.

Partnering with industry is the keystone of our strategy. ITP engages diverse segments of the industrial sector to tackle some of the toughest technological challenges facing the nation. Together we develop and deliver technology solutions with large potential impacts and build awareness of the many benefits of energy efficiency.

1.1 Market Overview and Federal Role

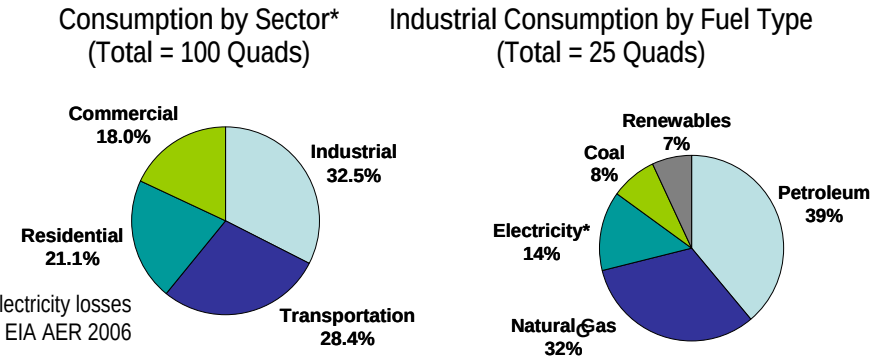
1.1.1 Overview of the Industrial Sector

The U.S. industrial sector consists of both manufacturing and non-manufacturing industries. Non-manufacturing industries are agriculture, mining (including the oil and gas extraction industries), and construction. Manufacturing industries include major process industries (e.g., chemicals, steel) and final fabrication industries that produce both durable and non-durable goods (e.g., auto manufacturing).

Industrial Energy Consumption

The industrial sector is the largest energy-consuming sector in the United States (Figure 1-a). In 2006, industry:

Figure 1-a. U.S Energy Consumption (2006)



- Consumed over 32 quadrillion Btu (quads), or about one-third of the 100 quads consumed in this country
- Lost nearly 22% of the energy input during the generation, transmission, and distribution of electricity to industrial facilities
- Used ~18 quads to meet heat and power demands of U.S. factories, farms, and mining and construction operations
- Used about 7 quads of fossil fuels as feedstock to produce materials and products such as chemicals and plastics
- Spent nearly $104 billion in the manufacturing sector alone for purchased fuels and electricity

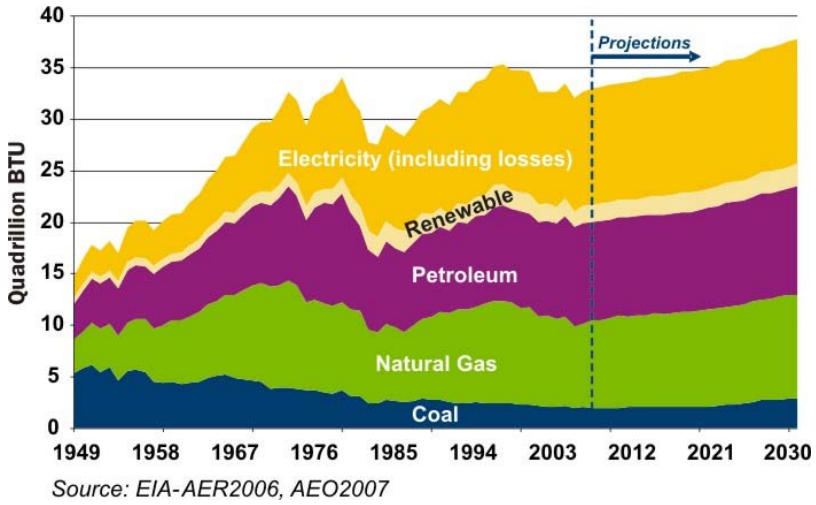
The industrial sector is also the most diverse energy-consuming sector in terms of both the types of energy services required and the mix of energy sources used to provide those services. Several crosscutting types of energy services are particularly important in this sector, most notably motor-driven equipment (representing nearly two-thirds of industrial electricity use), steam systems, and compressed air equipment. Beyond these crosscutting areas, industrial energy consumption tends to be process-specific. The industrial sector is also the most diverse energy-consuming sector in terms of both the types of energy services required and the mix of energy sources used to provide those services.

As shown in Figure 1-a, petroleum and natural gas account for the largest portion of primary industrial energy use at 39% and 32%, respectively. Electricity consumed at the point of use represents 14%, with coal and renewable energy sources accounting for the remainder of industrial energy consumption at 8% and 7%, respectively. In 2006, industry used over 3.3 quads of energy in generating its own electricity and process heat in combined heat and power systems. Figure 1-b shows trends (both historical and projected) in industrial energy use by fuel type. As shown in this figure, total industrial energy use is predicted to continue rising as industrial output grows between now and 2030. This trend highlights the need for getting more efficient technologies and practices in place *today* in order to curb total energy use and carbon emissions.

Industry and Energy Intensity

Energy use varies significantly from industry to industry. The majority of industrial energy use is concentrated in a small number of "heavy" manufacturing industries that transform raw materials into higher-value industrial materials and end products (see Figure 1-c). These industries also tend to be very energy-intensive, using large amounts of energy per dollar of product output.

While downstream fabrication and assembly industries such as automotive and aerospace may not be as energy-intensive as the major materials and process industries, these industries use materials with significant quantities of "embedded" energy. And fast-



Source: EIA-AER2006, AEO2007

Figure 1-c. The Manufacturing Value Chain

growing industries such as computers and electronic equipment, data centers, and ethanol producers are consuming a greater proportion of industrial energy use. This diversity inhibits a "one-size-fits-all" approach to energy efficiency.

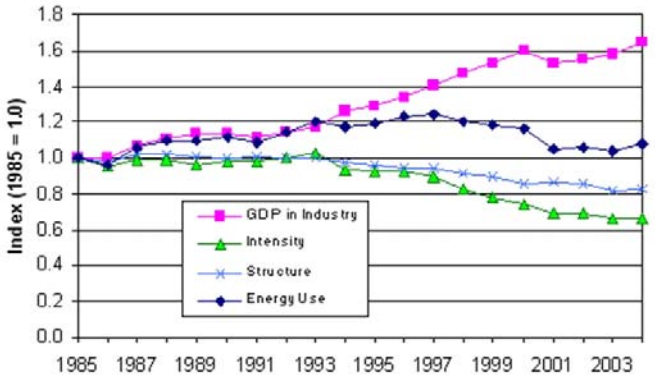
Despite considerable efficiency gains over the past 50 years, many industries continue to use far more energy than the theoretical minimum required for key processes, a gap that can be addressed by the development of new technologies and processes as alternatives to existing inefficient ones. In addition, large opportunities exist in industry to help our nation achieve energy and carbon reduction goals using currently available, state-of-the-art technologies and operating practices. In fact, a recent analysis by McKinsey identified an untapped pool of approximately 3.9 quadrillion Btu in industrial energy savings that are economically attractive (internal rates of return above 10%). The Industrial Technologies Program helps industry take advantage of *both* types of opportunities.

Industrial Energy Use Trends

Over the past 20 years, many factors have influenced industrial energy use -- increased utilization of recycled materials, availability of raw materials, stricter environmental standards, availability of more efficient technology, and shifts in product demand. In 2006, the U.S. economy posted its lowest energy intensity in 50 years (8,750 Btu/dollar of GDP - constant chained 2000). This ~50% drop from 1970 reflects the willingness of private industry to respond to economic signals and adopt energy-efficient technology. In fact, the DOE Policy Office determined that more efficient manufacturing was the largest component of total U.S. energy savings from 1970 to 1988.

Although manufacturing output surged in the late 1990s, energy use did not keep pace, despite relatively low energy prices. This ability to increase output without a corresponding increase in energy use is a major strength of U.S. industry (Figure 1-d).

Figure 1-d. Industrial Sector Energy Intensity Has Dropped Steadily Over the Past 20 Years



The industrial sector is expected to continue to provide one of the biggest opportunities to increase energy efficiency in the United States and worldwide (Figure 1-e). Industrial energy intensity is projected to decline as companies become more energy efficient and the composition of the industrial sector continues to shift. Industrial energy consumption is projected to increase by only 19% between 2005 and 2030, whereas the value of shipments is expected to increase by 65%. Figure 1-f depicts expected changes in value of shipments for several key industries.

Figure 1-e. Industry Presents the Biggest Opportunity to Increase Energy Efficiency Worldwide

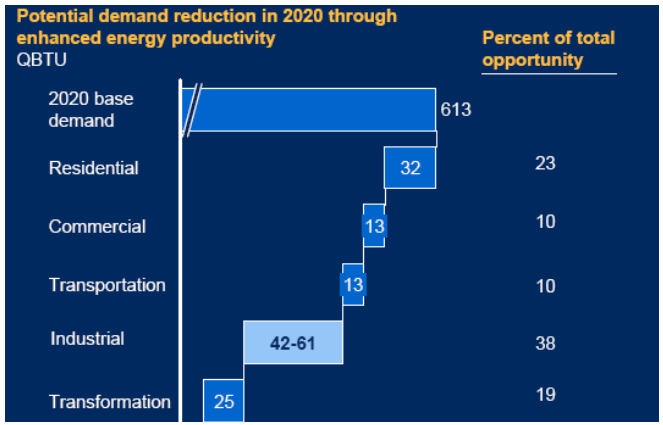


Figure 1-f. Many Industries Are Expected to Experience Strong Growth

Industry	Projected Increase in Value of Shipments, 2005-2030
Food Products	53%
Paper	37%
Petroleum Refining	33%
Chemicals	70%
Primary Metals	44%
Computers and Electronics	206%
Transportation Equipment	79%
Total Manufacturing	77%
Total Industrial Sector	65%

Source: EPA 2006

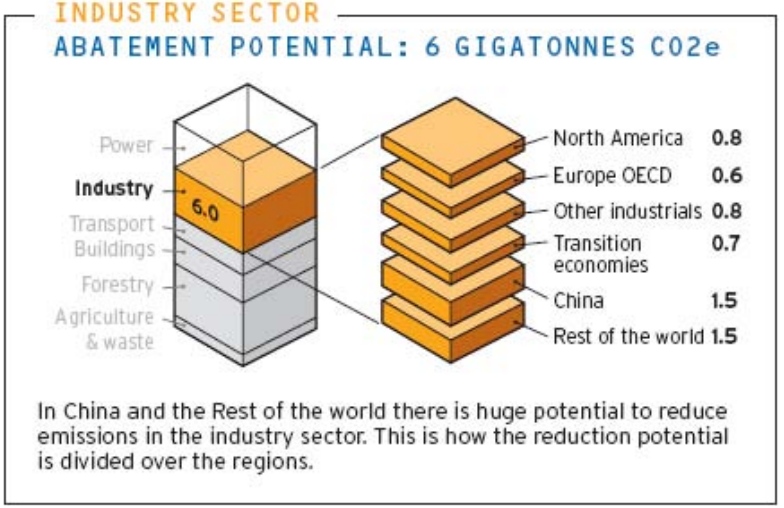
Energy use projections indicate that industry will continue to be a major source of future U.S. energy efficiency gains.

Industry, the Environment, and Carbon

Industry accounts for nearly a third of U.S. CO_2 emissions. The majority of industrial carbon emissions are related to combustion processes, including the generation of electricity. In addition, industry is responsible for about two-thirds of domestic non-CO_2 greenhouse gas emissions – particularly methane, nitrous oxide, HFCs, PFCs, and SF_6.

Analysis shows that *the cheapest and most available source of new energy for the industrial sector is the energy that is wasted every day*, which is why industry has led all other economic sectors in reducing its energy intensity. Higher efficiency and lower carbon intensity also translate into higher productivity. *In short, industrial energy efficiency presents a compelling opportunity for reducing national carbon emissions and energy intensity while increasing productivity*.

Figure 1-g. Global Opportunity to Reduce GHG Emissions from Industry Is Large (2030)



As the world's leading economy and largest consumer of energy, the United States is under increasing pressure to take more aggressive action regarding climate change. At the same time, China, India, and other developing countries are undergoing considerable economic growth, significantly expanding their manufacturing infrastructure in the coming years. Much of this expansion is occurring in basic industries such as steel, cement, and chemicals that have high energy consumption and carbon emissions. As a result, much of the opportunity to reduce industrial greenhouse gas emissions exists outside of North America. A recent Vattenfall report projects only 13% of the industrial opportunity by 2030 is represented by the United States and Canada (Figure 1-g).

Manufacturing industries also generate substantial quantities of hazardous and toxic wastes. Even with significant increases in production, manufacturers have significantly cut their generation and release of these wastes over the past decade. Environmental and climate change factors are playing an increasingly important role in corporate decision-making.

Economic Significance of Industry

U.S. manufacturers – comprising the largest portion of the industrial sector - shipped $5 trillion worth of products in 2006. Manufacturing industries employ nearly 13 million workers, about 12% of the Nation's total non-farm, private-sector employment. Beyond direct jobs, manufacturing industries indirectly support many other workers in supplier, repair, sales, finance, and other industries. Manufacturing alone represents about $1.5 trillion in GDP, or 12% of U.S. total GDP. Key economic statistics for U.S. manufacturing are shown in Figure 1-h.

The most energy-intensive manufacturing industries spend a significant portion of operating costs on energy, presenting major market opportunities for energy-efficient technologies, as shown in Figure 1-i. Other industries are also good strategic targets for efficiency improvement because of their significant contribution to the U.S. economy (Figure 1-j).

Industrial Markets and Competitive Landscape

U.S. manufacturers face intense competitive pressures. Strong cost competition from foreign producers and alternative products, as well as shareholder expectations of near-term profits, are squeezing corporate expenditures. In today's global economy, U.S. firms often find themselves at a cost disadvantage for labor, materials, energy, and environmental compliance. Unable to significantly differentiate their product from foreign sources in many cases, and with reduced trade barriers, increased trade deficits have occurred for most manufacturing industries. In addition, many products are pursuing the same markets. For example, steel, aluminum, glass, and plastics all target the food and beverage container market, as well as many automotive applications.

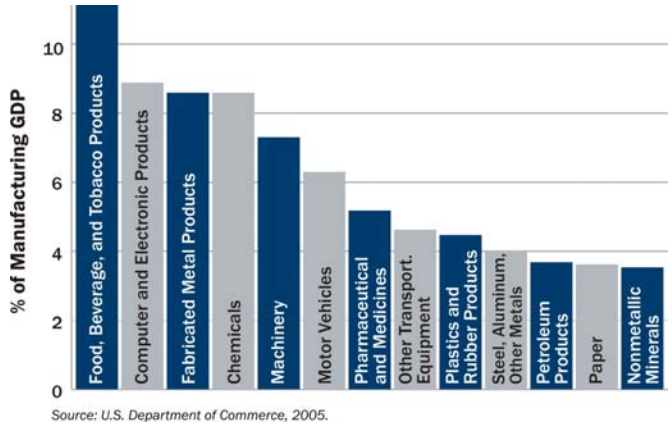
Figure 1-h. Salient Economic Statistics for U.S. Manufacturing Industries, 2006

Manufacturing Sector	Value of Shipments (billion)	Value Added (billion)	Employment (thousands)	Payroll (billion)	Capital Expenditures (billion)	Current Cost Net Capital Stock (billion)	Total Trade (billion)	Trade Balance (billion)
Durable Goods	$2,561	$1,216	8,120	$387	$70	$1,155	$1,606	$-471
Energy-Intensive Sectors (primary metals, nonmetallic minerals, wood products)	$471	$200	1,432	$60	$15	$232	$181	$-82
Other Sectors	$2,090	$1,016	6,688	$327	$55	$923	$1,425	$-389
Nondurable Goods	$2,459	$1,090	4,870	$205	$66	$882	$727	$-220
Energy-Intensive Sectors (paper, chemicals, petroleum refining)	$1,377	$565	1,263	$75	$37	$483	$437	$-90
Other Sectors	$1,082	$525	3,608	$131	$29	$399	$290	$-131
Total Manufacturing	$5,020	$2,306	12,990	$592	$136	$2,037	$2,333	$-692

To combat these competitive pressures, companies have cut costs and mitigated risk through mergers and acquisitions (both domestically and globally), leveraging R&D funds with private and public partners, globalizing and integrating R&D, and outsourcing technical components.

The critical role of many upstream manufacturing industries in the economy is often overlooked by the national media, and misunderstood by the public. Because the basic material building blocks – commodity materials -- these industries produce largely lose their identity when converted into usable consumer products, mass media advertising is not widely practiced by these industries. As a consequence, firms in these industries often are not widely recognized. In addition, these firms often cannot significantly differentiate their product in the marketplace from competitors. Many manufacturers in these industries have come to rely on superior production technology to increase productivity and throughput in order to capture a cost advantage. Another approach taken by

Figure 1-j. Industries that Contribute Heavily to U.S. GDP Are Strategic Targets (2005)



Source: U.S. Department of Commerce, 2005.

Figure 1-i. Market Data for Select Industrial Sectors[a]

Sector	2002 Energy Use (Quads)	2020 Energy Use (Quads)[b]	% of Operating Costs for Energy	Major Market Opportunities for New Technologies	2020 Deployment Potential/ Savings (Quads)[d]
Pulp and Paper	2.3	2.5	20-30	Improved drying, enhanced steam systems, efficient motor systems, combined heat and power (CHP)	0.6
Iron and Steel	1.4	1.4	5-15	Blast furnace/BOF and EAF applications, heat recovery (across all process steps), CHP, improved process controls, and new processes such as thin slab casting	0.3
Chemicals	6.5	6.6	2-7[c]	Process improvements (e.g., membrane separation techniques, new catalysts for petrochemicals, CHP	0.3
Petroleum Refining	3.5	4.7	~40	Process improvements, increased steam efficiency, higher furnace efficiency, CHP	0.3

a Based on McKinsey 2007 report "The Untapped Energy Efficiency Opportunity in the U.S. Industrial Sector"
b Projected by Energy Information Administration.
c Excludes feedstock expenditures.
d Potential above business-as-usual case through implementation of financially attractive (>10% IRR) energy-saving technologies.

some vertically integrated companies is to enhance or upgrade their products, leading to greater brand recognition and higher profits.

This approach results in a significantly different business environment than exists for downstream high technology, aerospace, or service industries. In downstream industries, brand recognition and product differentiation is more prominent. Companies gain advantages by using copyrights, ensuring significant product development lead times by adding new features and functionality, holding dominant market positions, and owning technology standards.

1.1.2 Overview of State, Local and International Political Environment

Federal Environment

The Federal government does not have a unified voice regarding industrial issues; objectives and priorities within different Federal agencies are dependent on their individual missions. Manufacturing has received increased emphasis within the Bush Administration, culminating with the Department of Commerce publication entitled *Manufacturing in America: A Comprehensive Strategy to Address the Challenges to U.S. Manufacturers*. The report recommended several actions the government should take to enhance government's focus on manufacturing competitiveness.

Many of the benefits of saving energy in industry accrue to society rather than within the organization that makes the investment. These social benefits include enhanced energy security, reduced dependence on foreign energy sources, and avoided emissions of NOx, CO_2, and other pollutants. Companies have less incentive to invest in energy-efficient technologies because they cannot capture all the benefits.

Governmental programs can play a supporting role in helping companies deal with their own inefficiencies and more consistently pursue economically viable projects. To do this, the government can focus on removing internal barriers, including informational and motivational programs to disseminate "best practices"; targeted capital programs to push select investments past the tipping point; and removal of external regulatory barriers that hold companies back from capitalizing on energy efficiency.

Increasing concern throughout the Federal government on climate change is reshaping the Federal environment. To date, efforts have centered on voluntary commitments from industries to reduce carbon emissions, and on R&D activities to develop the next generation of low-carbon technologies.

Two bills of particular importance have been enacted in the past few years that affect ITP:

- *Section 106 of the Energy Policy Act of 2005* allows the Secretary of Energy to enter into voluntary agreements with industrial entities that consume significant quantities of energy. The goal of each agreement is an energy intensity reduction of at least 2.5% annually between 2007 and 2016 by the participating entity.
- *Section 452 of the Energy Independence and Security Act of 2007* directs the Secretary of Energy to establish a program under which the Secretary, in cooperation with energy-intensive industries and national industry trade associations representing the energy-intensive industries, shall support, research, develop, and promote the use of new materials processes, technologies, and techniques to optimize energy efficiency and the economic competitiveness of the United States' industrial and commercial sectors. Energy-intensive industries defined in the Act include:
  - Information technology, including data centers containing electrical equipment used in processing, storing, and transmitting digital information
  - Consumer product manufacturing
  - Food processing
  - Materials manufacturers, including aluminum, chemicals, forest and paper products, metal casting, glass, petroleum refining, mining, and steel
  - Other energy-intensive industries, as determined by the Secretary

  The Act also authorizes funds to be appropriated to conduct this program in the amounts of: $184 million for fiscal year 2008; $190 million for fiscal year 2009; $196 million for fiscal year 2010; $202 million for fiscal year 2011; $208 million for fiscal year 2012; and such sums as are necessary for fiscal year 2013 and each fiscal year thereafter.

State/Local Needs

ITP's implementation of state activities is conducted through the Golden Field Office and the National Energy Technology Laboratory. Emphasis has been placed on working with the largest energy-using plants throughout the Nation to help them access ITP's resources. These results will be included in the overall ITP metrics.

The Office of Energy Efficiency and Renewable Energy has created a Federal State Partnership known as the State/Federal Collaborative Pilot Program (STAC). This is collaboration between the Department of Energy, the National Association for State Energy Officials (NASEO), and the Association for State Energy Research and Technology Transfer Institutes (ASERTTI). The STAC program is run through competitive solicitations requesting proposals through six committee areas, one of which is the industrial sector. Once a decision is made regarding specific technology areas for each committee, a solicitation will be widely disseminated. Proposals will be funded with a minimum 50% cost-share from States and companies.

International Environment

Internationally, governments are generally supportive of the industrial sector. Developing countries are very interested in expanding their technological base and creating manufacturing jobs. In addition, some foreign governments provide significant subsidies to industry, resulting in a lower cost of capital. For example, companies operating in China are estimated to have a cost of capital closer to 5% as a result of government subsidies.

For the last twenty years, there have been significant efforts throughout the world to reduce emissions of greenhouse gases. The Intergovernmental Panel on Climate Change (IPCC) has produced a number of reports on the potential impact of global warming, science, and mitigation, resulting in a dramatic increase in awareness and concern about climate change. The 4th Assessment Report from the IPCC indicated a much higher probability of human influence on the climate. As the world's leading economy and largest consumer of energy, the United States is under increasing pressure to take more aggressive action regarding climate change.

1.1.3 Competing Technologies and Technology Environment

Energy-efficient technologies compete with less-efficient alternatives for market share. Often, initial equipment price is the primary factor considered instead of a life-cycle approach. This leads to the installation of technology that not only is less energy-efficient, but in the end, costs more.

Technology development is performed both by companies in particular industries and also equipment vendors. Industrial research and development is discussed further in the following sections.

Industrial R&D

Energy-intensive industries are severely constrained in their ability to invest in R&D due to their low profit margins and inability to fully appropriate R&D benefits to their companies. In recent years, R&D investments in the energy-intensive industries have not kept pace with the rest of the economy. From 1994 to 2003, R&D investments for the energy-intensive industries grew by only 1.3% per year, compared to 4.4% per year for all of manufacturing. As a result, the portion of total manufacturing R&D contributed by the energy-intensive industries fell from 13% to 10%.

Process technologies that use less energy per unit of output are logical investment opportunities for energy-intensive industries, but energy-intensive manufacturers are often unable to invest in energy-related process R&D without government assistance. Companies in these industries are unable to accept the costs and risks associated with undertaking complex, capital-intensive technology development and implementation for highly efficient, next-generation process technologies. These technologies are seen as too expensive and risky, and unlikely to provide adequate long-term return to the firm, potentially resulting in lost production. In fact, the risk of lost production often overshadows all other factors in the decision not to invest in energy-efficient technologies.

As a result of perceived risks, most manufacturers favor R&D investments that incrementally improve existing technology platforms, rather than exploring transformational technologies. While this "optimize and extend" strategy carries less risk and produces near-term returns, it also prevents companies from investing in the very technologies that can help ensure their long-term competitive advantage.

R&D risks that are often cited by industry include:

- Technology development risk
- Increased risk with larger project size and complexity
- Changing market conditions

- Regulatory risk
- Internal management, culture, and resources

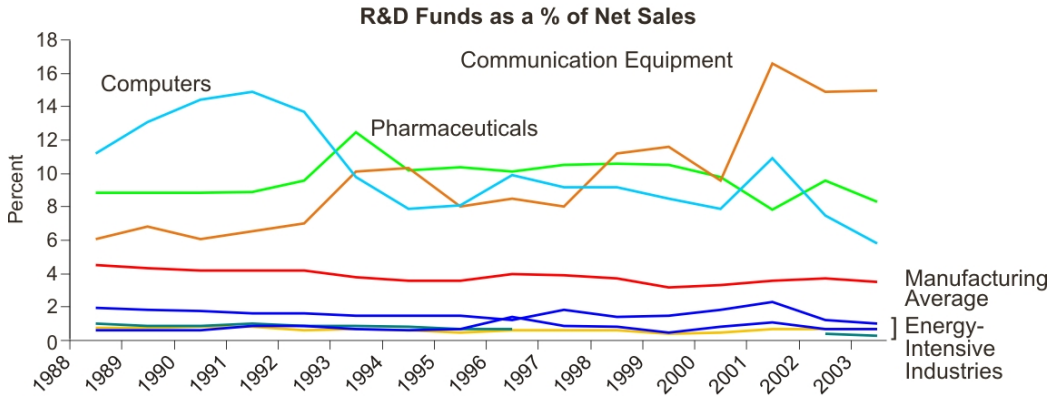
The cost of technology failure in mature industries can be extremely high. While a significant invention may lead to a temporary cost advantage for individual firms, it seldom leads to a long-term competitive advantage in the marketplace.

R&D Investment Comparison

Mounting evidence indicates that industry is severely underinvested in R&D for technologies that can improve energy efficiency. If this underinvestment is caused by market failures, the Federal government has a valid role in trying to correct the failure.

The energy-intensive industries have the lowest R&D investment rate in the entire industrial sector, with R&D spending at a rate of only 1% of sales. This compares with an average of R&D spending of about 4% of sales for all of industry (Figure 1-i).

Figure 1-i. Energy-Intensive Industries Have Lowest R&D Investment



Alternative stimulants to technology development such as tax incentives and R&D tax credits are generally inappropriate for developing energy-efficient process technologies. These incentives are blunt policy instruments that increase all types of R&D investment, and may subsidize R&D that would occur without public support.

Average Cost of Capital

With relatively low profit margins, many companies in the manufacturing sector face higher than average financing costs. On average, the cost of capital in these industries is about 10%. Many companies in these industries have seen their credit downgraded by rating agencies as foreign competition, along with high legacy costs for employee health care and pension plans, and asbestos litigation settlements, which have severely impacted profitability. Several well-known companies in these industries have filed for bankruptcy protection over the past few years, including Bethlehem Steel, Owens Corning, Kaiser Aluminum, and W.R. Grace. A sample of current credit ratings for leading companies in various manufacturing industries is shown in Figure 1-j. Other companies in these industries with less-stellar financial results would have substantially lower ratings.

Furthermore, within companies in manufacturing industries, capital resources must be prioritized and investment in energy efficiency and process R&D generally receives a low priority.

Options for Expanding Production

There are three main avenues in which manufacturing firms can expand their domestic production: greenfield development, retrofit expansions, and acquisitions. Little greenfield development has occurred in most heavy manufacturing industries over the past twenty years for virgin material production. These industries are cyclical in nature, and significant overseas expansion led to global overcapacity. Advances in technology, however, have led to the development of new facilities that use recycled materials, such as scrap-based steel mills, newspaper recycling plants, and aluminum remelting facilities. While states often compete vigorously by providing significant tax incentives for new fabrication facilities, such as automobile assembly plants, this is rarely the case for facilities in the energy-intensive industries. The very nature of these industries, which often are highly automated and perceived to have undesirable qualities, limits their attractiveness. In addition, the approval and permitting process for new facilities, especially in states with more stringent environmental requirements, can take years, and result in significant costs before construction even begins. As an example, even though consumption of petroleum has grown 20% over the last twenty years, the last new petroleum refinery was commissioned in 1983.

Figure 1-j. Bond Ratings of Various Industrial Firms

Industry	Company	Rating (S&P)
Paper and Wood Products	Weyerhaeuser MeadWestvaco	BBB BBB
Petroleum	ExxonMobil Valero Energy	AAA BBB
Chemicals	Dow Chemical Praxair	A- A
Computers and Electronics	Intel Hewlett-Packard	A+ A
Primary Metals	Nucor Alcoa	AA- BBB+
Transportation Equipment	General Motors Boeing	B A+
Diversified Manufacturing	General Electric United Technologies	AAA A

The majority of actual production expansion in heavy manufacturing industries comes from investments at existing facilities. Some of this expansion is the direct result of improvements in productivity, which allow for increased throughput of existing equipment. Space permitting, additional unit operations can be added to increase capacity. Unfortunately, there are inherent disadvantages to retrofitting existing plants, in particular as they relate to energy efficiency. More modern designs, improved space utilization, and newer equipment would make a new plant much more efficient than retrofitting an existing plant on a piece-meal basis.

Companies in heavy manufacturing and mining industries have often decided that acquisitions or mergers are more suitable than greenfield development to expand market share. One popular reason for this strategy is the speed of an acquisition compared to the time for permitting and building a new facility. The acquired firm also brings existing customers for the plant's output. In addition, the technologies, expert management, research results, and innovation of the acquired company become the property of the acquiring firm. With less stringent anti-trust rules, this has led to significant consolidation in many manufacturing industries over the past 20 years.

As a result, in December 2006, crude processing had much higher capacity utilization rates than primary and semifinished processing and finished processing, as depicted in Figure 1-k.

On the other hand, the high-tech manufacturing sector has experienced phenomenal growth during this decade. Capacity has more than doubled in this area, which includes computers, semiconductors, and communications equipment.

Capital Expenditures and Stock Turnover

The manufacturing sector accounted for about $2.037 trillion in current-cost net capital stock of fixed assets in 2006. Capital expenditures by manufacturing firms were $136 billion in 2006, about 3% of sales. A significant portion of industry's capital investments is required to meet environmental standards, further limiting opportunities for replacing production equipment with more efficient technology or building new facilities.

Because manufacturing industries are already relatively energy-efficient, opportunities for further improving efficiency are closely interlinked with the industrial process or production system itself. Technological innovations are strongly influenced by considerations other than energy efficiency. Without major improvements in technology in these industries, capital productivity has stagnated, resulting in low investment returns and low capital stock turnover.

Furthermore, energy-intensive industries remain conservative where the risk is significant and the savings associated with installing a new technology are not guaranteed. The cost of lost production due to plant shutdowns can far outweigh minor cost savings. Other potential risks include:

- Negative effect on product quality
- Unexpected process impacts
- Higher-than-expected initial and/or operational costs

The larger the size of plants and production capabilities, the more hesitant companies are to implement innovations that involve technical and economic risks.

Figure 1-k. Industrial Capacity and Utilization

Category	Change in Capacity, 2000-2006	Utilization, December 2006
Overall Manufacturing	8.8%	80.3%
Crude Processing	-1.5%	89.6%
Primary and Semifinished Processing	7.7%	81.7%
Finished Processing	10.4%	79.0%
Mining (excluding oil & gas)	1.6%	85.5%
High-Tech Manufacturing (computers, semiconductors, communications equipment)	128.8%	79.4%

Companies are reluctant to be the first adopter of a new technology, even one whose performance has been demonstrated and validated. The cost of failure could be fatal to the company or their competitive position. Many corporate managers in risk-averse industries declare they want to be "the first to be second" in deploying new technology. Often the third, fourth, or fifth installation of a technology can be at least 30% less expensive than the first because of increased knowledge and experience gained from prior installations.

As with all manufacturing industries, investment decisions are affected by implied return on investment. Companies employ a variety of methods to evaluate investment opportunities, including net present value, internal rate of return, and payback period. The results from these methods are also linked with Federal tax policy. In particular, the tax treatment for depreciating equipment purchases can significantly influence investment decisions.

1.1.4 Market Barriers

U.S. industrial firms have a large potential to profitably implement energy efficiency technology and processes, but a number of market barriers prevent companies from capturing these opportunities. Some of these barriers lie within companies and are present at the senior executive level or on the ground with line managers. Other times, government

regulations present barriers to companies. This includes, but is not limited to, the uncertainty of future legislation and existing regulatory restrictions, both of which impose hurdles to successful energy efficiency investment.

Within a company, barriers to pursuing energy efficiency opportunities take two forms. First, energy efficiency decisions may not make it to the senior executive's agenda and thus are delegated to line managers. Second, these line managers who are responsible for making decisions face many obstacles. They often have incomplete information, a lack necessary personal incentives to drive energy efficiency, and a competition for capital with other company projects that are either mandatory or much larger.

Energy-efficient technologies compete with less-efficient alternatives for market share. "First cost" is often the primary factor considered in these decisions rather than life-cycle cost, which leads to the installation of technology that not only is less energy-efficient, but ends up costing more over the life of the equipment.

Other market barriers to technology development and deployment include:

- *Globalization and consolidation* of companies in energy-intensive industries. In some cases, ownership of U.S. based facilities is being transferred to foreign owners.
- *Reduced R&D staff* within industry, limiting R&D efforts to improve energy efficiency.
- *Difficulty obtaining venture capital for process development* in the more mature energy-intensive industries.
- *Low profitability* together with high capital intensity, high environmental compliance costs, and high energy prices, resulting in low investment returns.
- *Insufficient information for decision-makers* to help them choose energy-efficient technologies.
- *Corporate preference for incremental changes* such as low-risk process improvements over transformational technologies.
- *Environmental regulations* that often act as a significant barrier to the testing, evaluation, and commercialization of new improved technologies.

1.1.5 Program History and Major Accomplishments

Program History

The Industrial Energy Conservation Program began in 1975 under the mandate of the Federal Non-Nuclear Energy Research and Development Act of 1974. This Act directed that a comprehensive program be conducted to improve the efficiency of energy use in the industrial sector through R&D of high-risk, innovative technologies. The program was further shaped with the passage of the Department of Energy Organization Act of 1977, effectively merging all Federal Energy Agency and Energy Research and Development Administration programs. This led to the creation of the Office of Industrial Processes (OIP), ITP's organizational predecessor.

As OIP's experience and success in energy efficiency RD&D projects grew, the Program began responding to the changing needs and priorities of its principal customers. Competitive threats to U.S. industries arising in the 1980s led OIP to emphasize productivity, capital efficiency, and quality in addition to energy efficiency. Industrial waste reduction and pollution prevention also became critical elements of the Program's RD&D

Figure 1-I. Impacts of ITP (and Predecessor Organizations)

Metric	Results
Technologies Commercialized	190+
Energy Savings 2005 Cumulative	402 trillion Btu 5,130 trillion Btu
Environmental Benefits (Cumulative) Carbon SOx NOx VOCs	103.0 million tons 1.62 million tons 810 thousand tons 28.1 thousand tons 25.2 thousand tons
R&D 100 Awards	42

portfolio. The passage of the Steel Initiative in the mid-1980s (and later the Metals Initiative) led to increased program investment in new steel and aluminum process technologies.

Around 1990, OIP was reorganized into the Office of Industrial Technologies (OIT). By 1994, OIT had changed its program strategy and adopted an innovative, industry-driven approach known as *Industries of the Future* to be more responsive to customer needs. Key components of OIT's strategy included:

- Focusing investments on the most energy-intensive industries
- Using collaborative partnerships among industry, government, and the research community to optimize intellectual and financial resources
- Encouraging industry to identify and cost-share pre-competitive technology priorities critical to future success

This approach responded to industry's need to leverage investments for high priority, pre-competitive technologies where the expected risks and returns did not warrant private investment. Technology transfer aspects of OIT were consolidated into the Best Practices program. In addition, the OIP-initiated Energy Analysis and Diagnostic Center (EADC) program - a university-based program to provide plant energy audits - broadened its focus to include productivity and environmental aspects, and was renamed the Industrial Assessment Center program.

In 2002, as part of a broader EERE reorganization, OIT was renamed the *Industrial Technologies Program (ITP)*. Since this time, ITP has faced declining budgets, but increased its analytical activities and refocused its research on crosscutting, high-impact R&D. Figure 1-l highlights the Program's success over the past several decades.

Major Accomplishments

Since its inception, ITP and its predecessors have had great success in supporting the development and implementation of energy-efficient technology:

- Total cumulative energy savings of more than 5 quads, representing production cost savings of nearly $30 billion
- Around 85 commercialized technologies currently being used throughout industry.
- 42 prestigious R&D 100 Awards

Figure 1-m. 200 *Save Energy Now* Assessments Were Completed in 2006

The Industrial Assessment Center (IAC) program has been successfully generating energy savings for over 28 years. Currently, twenty-six IACs located within engineering departments of U.S. universities conduct comprehensive energy assessments for small- and medium-sized manufacturers and train the future workforce of energy engineers. Recommendations from industrial assessments have averaged more than $58,000 in implemented annual cost savings per plant. Since 1980, 13,500+ audits have been completed by the EADC/IAC programs.

ITP's Best Practices activity works with industry to identify plant-wide opportunities for energy savings and process efficiency. Through the implementation of new technologies and systems improvements, companies across the United States

are achieving immediate savings results. Over 16,000 U.S. manufacturing plants have been impacted by Best Practices; many of these plants have implemented new technologies and practices to achieve immediate savings results.

Best Practices launched the *Save Energy Now* initiative in 2005 to help companies respond to the natural gas crunch. Under this initiative, ITP cost-shares intensive three-day assessment s with companies, providing energy experts who work closely with the Plant Lead and other key personnel to identify target opportunities.

The centerpiece of the *Save Energy Now* initiative in 2006 was the delivery of 200 energy savings assessments to large manufacturing plants (Figure 1-m). DOE completed these assessments and results highlight the potential for significant energy savings in U.S. industry:

> *"Save Energy Now has helped us find creative ways to save energy and reduce carbon emissions in our manufacturing processes -- all while delivering the same great products our consumers love."*
>
> *-- Dick Frohmader, Program Manager for Global Energy, Kraft Foods*

- The typical large plant can cut its energy bill by 10% or more each year (over $2.5 million per plant, on average).
- New energy savings opportunities were identified in most plants—even plants with in-house energy teams.
- The three-day assessments prompted most of the participating plants to undertake or seriously consider implementing the recommendations—demonstrating that even relatively quick assessments can identify feasible, worthwhile projects

1.1.6 Program Justification & Federal Role

National Need Addressed by Program

Reliable, affordable, and environmentally sound energy for America's future is the cornerstone of the National Energy Policy (NEP). Yet an expanding economy, growing population, and rising standard of living create growing demands for energy. Modernizing energy conservation is one of five national goals included in the NEP. Further, "the best way of meeting this goal is to increase energy efficiency by applying new technology – raising productivity, reducing wastes, and trimming costs." Accordingly, ITP's strategy and implementation plan is critical to the successful implementation of the NEP, since the industrial sector uses a third of the Nation's energy.

Need for Government Involvement

Many of the highly energy- and carbon-intensive industries manufacture basic materials and industrial commodities such as steel, cement, glass, aluminum, and chemicals. In the United States, these are typically mature industries that operate on small margins, providing little opportunity for large capital investment in new technology that will increase energy and material efficiency. Since the mid-1970s, these energy- and material-intensive manufacturers have adopted many energy-efficient technologies and practices, particularly in large plants. However, additional opportunities to adopt smart energy and waste reduction practices exist in non-energy-intensive industries and in all small- to medium-size facilities.

To capture these opportunities, companies require the appropriate information, assessment tools, and specialized expertise to identify cost-effective measures. Manufacturers can then justify costs and make appropriate investments in technologies and practices.

The introduction of more advanced manufacturing technology is difficult for many industries because of the technical and operational risk of developing and implementing a promising, but unproven, technology. Round-the clock operations combined with small margins renders even a small risk of technical glitches too costly for many companies. In such cases, the government has an appropriate role to help demonstrate and cost-share the first application of promising carbon reduction technologies.

Perhaps the biggest opportunity to reduce industry's energy and carbon intensity is to develop next-generation manufacturing concepts and technologies that break with traditional production strategies. Certain opportunities are limited by constraints in the existing manufacturing infrastructure, which represents hundreds of billions of dollars in cumulative

capital investment over many decades. Many of the basic processes used to make aluminum, glass, and other materials have changed little over the past 100 years. However, entirely new manufacturing platforms, alternative chemical processing routes, nanomanufacturing, and integrated energy, heat, and material systems have the potential to deliver very low energy and carbon footprints for new manufacturing facilities.

Development of radically new industrial technologies requires significant investment in fundamental sciences, technology development, engineering, and demonstration. Such resource requirements are beyond the reach of even the largest companies—and often entire industries—without government facilitation and support. The diverse technical and financial resources required for these complex technology platforms create significant technical and economic barriers. The government has a clear role both in supporting the fundamental science that can lead to innovation and in providing early-stage technology research and development that can accelerate technology concepts to the point at which they can attract private investment for commercial development.

Unique and Critical Program Aspects

The Industrial Technologies Program has several unique and critical aspects:

- *ITP is the sole government program focused on reducing energy demand in and costs to industry*, which benefits U.S. energy security, competitiveness and the environment.
- *The U.S. government's investment in energy efficiency technologies is small compared with competitors*, Japan invested over 5 times as much in 2003 ($300 million) as the current ITP funding request, with an economy half the size.
- *ITP invests in "pre-competitive" R&D* with academics, national labs, and many small entrepreneurial businesses - addressing a growing gap between basic research and the marketplace and grooming U.S. technology vendors with exportable products.
- *ITP catalyzes R&D investment within and across industry*, supporting large R&D projects that could not be funded by industry itself. Many companies praise ITP's role in putting together collaborative R&D partnerships, developing technologies they would not be able to bring to market alone, and catalyzing industrial investment in both technology development and near-term savings opportunities.

Complimentary Federal Programs

ITP coordinates with other Federal agencies such as NIST, NSF, and DOD to organize research efforts in common areas and on key manufacturing technology issues. Within DOE, ITP has numerous relationships with other EERE programs, coordinating with:

- FEMP on the application of CHP in federal facilities.
- Solar Energy Technologies program on glass manufacturing for photovoltaic systems.
- DOE's Office of Science on translating discoveries in basic science (e.g., nanoscience) into technologies applicable in industrial processes (nanotechnology and nanomanufacturing efforts are coordinated by the National Nanotechnology Initiative, with participation from many Federal agencies)
- NIST on advanced manufacturing technologies
- EPA on pollution prevention and climate change activities aimed at industry

Context of Program within EERE

ITP has numerous relationships with other EERE programs (including FEMP and the Solar Technologies Program, as just described). Manufactured products are used extensively in the transportation and buildings sectors, and research activities and interests sometimes overlap.

1.2 Program Vision

ITP's vision is that U.S. industry leads the world in energy efficiency and productivity.

1.3 Program Mission

The Industrial Technologies Program (ITP) leads the national effort to reduce energy use and carbon emissions in industry. To carry out our mission of transforming the way U.S. industry uses energy, ITP develops and promotes new technologies and practices that improve industrial energy efficiency both today and tomorrow. To this end, we support cost-shared research and development (R&D) to address the top energy challenges facing industry while fostering the adoption of today's advanced technologies and best energy management practices. We want energy-efficient technology to be the first choice when industry replaces equipment or constructs new facilities. Transforming the way industry uses energy requires a strategic, concerted effort led by the federal government. Meaningful progress in reducing industrial energy intensity requires accelerated adoption of the many energy-efficient technologies and practices available today, as well as vigorous technological innovation to radically improve future energy diversity, resources efficiency, and carbon mitigation.

ITP's three-part strategy is designed to deliver results (Figure 1-n). We:

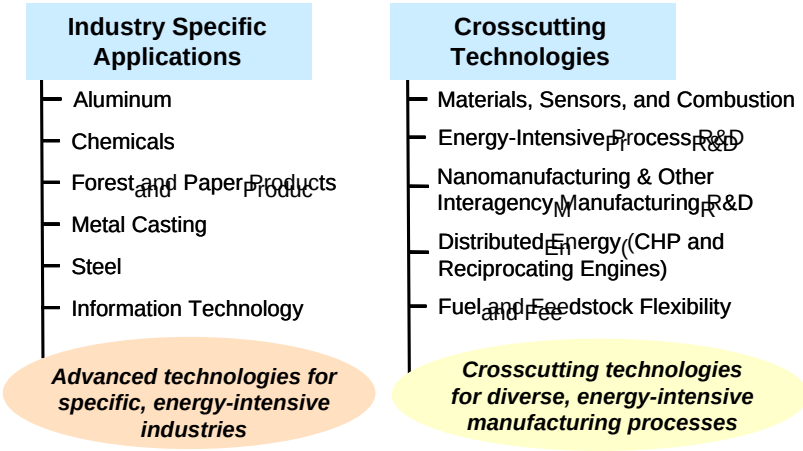
- Sponsor research, development, and demonstration (RD&D) of technologies to reduce energy and carbon intensity
  - Industry specific applications
  - Crosscutting technologies
- Conduct technology delivery activities to help plants access today's technology and management practices
- Promote a corporate culture of energy efficiency and carbon management within industry

At its most basic level, this strategy seeks to condition the market, invest strategically in technology R&D, and deliver highly efficient technologies and practices to a receptive industrial stakeholder base.

In line with our mission and vision, ITP has embraced an overarching goal of driving a 25% reduction in industrial energy intensity by 2017, in accord with the *Energy Policy Act of 2005*. This Save Energy Now - "25 in 10" - initiative delivers resources to help all companies nationwide boost their energy efficiency—whatever their current level of energy performance.

Figure 1-n. ITP's Three-Part Strategy

Figure 1-p. Structure of ITP's R&D Activity



1.4 Program Design

1.4.1 Program Structure

ITP strives to accelerate the development of energy-efficient technologies ready to enter the market in the near term, while conducting groundbreaking research on revolutionary technologies for the future. Our applied R&D focus effectively turns knowledge and concepts initiated by others into real-world energy solutions. With our industry partners, we support research, development, and demonstration activities in both industry-specific and crosscutting areas (see Figure 1-p).

We identify the best opportunities for energy savings through comprehensive technical and market-based analysis and planning. Our industry-specific activities seek to improve the performance of America's most energy- and carbon-intensive industries. The broader initiatives in our crosscutting area focus on high-impact R&D with applications throughout the industrial sector. Once they reach the later stages of development, technologies supported in our crosscutting area are typically demonstrated in one or more specific industrial applications, often in the energy-intensive industries. This dual approach dramatically improves the energy efficiency and environmental performance of the most energy-intensive industrial processes.

R&D Activities

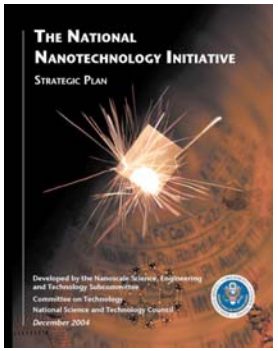
Industry-Specific R&D

ITP engages key energy-intensive industries to develop solutions to the most challenging process-specific priorities. We work closely with its industry partners – often through industry trade and technical associations – to identify these priorities and potential pathways for addressing them. The Program has received strong praise from industry for its role in bringing together companies within an industry to address common technical issues. Our strategy has been to focus scarce resources on high-risk, high-payoff R&D by selecting the best opportunities, leveraging intellectual and financial resources, condensing technology development cycles, and accelerating commercialization and deployment. Currently, the Program is conducting industry-specific R&D in five industries (as shown in Figure 1-r).

Crosscutting R&D

ITP's main R&D focus is on cross-cutting activities that could achieve large energy benefits throughout the manufacturing supply chain. In our crosscutting activities, we work with industrial partners and equipment suppliers to conduct cost-shared research, development, and demonstration on technologies that have potential applications across many segments of industry. Our Energy Intensive Process (EIP) activity – which is structured along "platforms" of technological focus that provide the framework for cost-shared projects -- is the largest component of our crosscutting R&D area. Currently, we are:

- Initiating R&D in four EIP technology platforms
  - Waste Heat Minimization and Recovery
  - Industrial Reactions and Separations
  - High-Temperature Processing
  - Sustainable Manufacturing
- Completing key projects in Sensors and Automation (new sensors projects are being conducted under the EIP activity)



DOE is one of 25 Federal agencies working together to develop next-generation nanotechnologies.

- Continuing R&D in Industrial Materials of the Future and Combustion R&D (complemented by R&D in the EIP platforms)

ITP is also exploring innovative new approaches to expand efficiency throughout the industrial sector. We strive to maintain a full "R&D pipeline" of technologies that could revolutionize manufacturing in the future. We also support industrial applications of existing technologies that will transform the market for combined heat and power and other distributed generation systems, and promote industrial fuel and feedstock flexibility. Specific activities include:

- *Nanomanufacturing and Other Interagency Manufacturing R&D*: We coordinate with other government agencies on next-generation research, focusing initially on processes for the mass production and application of nano-scale materials, structures, devices, and systems for industrial applications.
- *Distributed Generation*: We promote widespread deployment of Combined Heat and Power (CHP) and Advanced Reciprocating Engine Systems (ARES) throughout the United States.
- *Fuel and Feedstock Flexibility* activities: We support the development and deployment of alternative fuel and feedstock technologies to replace natural gas and oil. This targeted, deployment-focused initiative links industrial users with advanced fuel development activities taking place throughout DOE (e.g., EERE's Biomass Program, the Fossil Energy office, etc.) and the National Laboratories.

Technology Delivery

To capture the energy-savings opportunities presented by both new technologies and existing best energy management practices, companies require the appropriate information, assessment tools, and specialized expertise to identify cost-effective measures. Manufacturers can then justify costs and make appropriate investments in technologies and practices.

The dissemination of energy-efficient technologies and operating practices is at the core of ITP's strategy. Through our outreach efforts—voluntary pledge agreement, tools, training, plant assessments, technology demonstrations, website, and other resources—we are able to help companies access resources to save energy today.

ITP's *Save Energy Now Leader* initiative will encourage leading industrial companies, plants, and supply chains to pledge to reduce their energy intensity by 25% over a 10 year period. As part of this initiative, ITP provides resources and incentives to help companies implement energy- and carbon-reducing technology solutions. We work directly with companies who sign the pledge, and help other companies either directly or indirectly through state, utility, and other partners. The Program continues to provide industrial process application tools relevant to major energy systems – including steam, pumping, process heating, and compressed air systems -- emphasizing system-level improvements.

"While [Dow] has long been a leader in energy efficiency, with DOE's help we found yet more cost-effective opportunities to save energy."

-John Dearborn
Global Business VP for Energy
Dow Chemical Company

Save ENERGY Now

U.S. DEPARTMENT OF ENERGY INDUSTRY PARTNERSHIP LEADER

Save Energy Now Leaders – Meeting the "25-in-10" Goal

Save Energy Now is a national initiative to drive a 25% reduction in industrial energy intensity in ten years. It delivers resources to help all companies boost their energy efficiency—no matter where they stand along the energy performance continuum.

Save Energy Now is about action. The initiative reinforces energy efficiency as a profitable business model. It makes available a broad range of resources to help industry identify and implement cost-effective options for energy savings. The portfolio of resources will be expanded over time to fill existing gaps, paving the way for free enterprise to affirm America's leadership in energy technology.

We invite industrial companies and plants to make a bold Pledge to reduce their energy intensity and associated carbon emissions as part of their cost-reduction strategy. Companies and plants are encouraged to make a Pledge that is ambitious yet achievable for their operations. Taking the Pledge demonstrates that they are dedicated to:

- Using energy-efficient processes, technology, and practices
- Fostering industrial energy efficiency and using materials and products made with energy-efficient processes
- Making continuous investments in energy efficiency and carbon reduction as part of their business strategy

Building off the success of 450 completed Energy Savings Assessments (ESAs) in 2006 and 2007, ITP continues performing plant energy assessments, sending energy experts to the Nation's most energy-intensive manufacturing facilities to identify immediate opportunities for saving energy and money. The Industrial Assessment Centers program continues to enable eligible small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturer.

Corporate Culture of Energy Efficiency

ITP is cultivating a corporate culture of energy efficiency and environmental stewardship throughout U.S. industry. Energy efficiency is a sound business strategy that yields huge benefits. ITP is spearheading major efforts to raise awareness of opportunities and encourage investments in energy efficiency throughout the public and private sectors. The Program is developing and implementing a comprehensive strategy that clearly defines key messages, products, channels, partners, and events necessary to transform the way industry thinks about and uses energy.

To elevate energy efficiency as a priority within industry, ITP will:

- *Serve as the federal resource for industrial energy efficiency* by providing unbiased, reliable information
- *Shape the direction of the industrial market relative to energy efficiency* in collaboration with individual corporate leaders, the National Association of Manufacturers, the Business Roundtable, and other high-level business organizations
- *Foster voluntary corporate commitments* to reduce industrial energy intensity
- *Support third-party certification of plant energy efficiency* to create a standard of excellence and guide investments
- *Encourage energy efficiency up and down supply chains* by providing guidelines to help companies develop and implement policies and protocols
- *Provide energy analysis and management resources* to help diverse industry segments establish energy use baselines
- *Provide flexible energy planning resources to corporations* to encourage programs and goals for energy efficiency

Organization

The current ITP structure has been instituted to provide a balance between various program elements, budget, management/staff ratio, and responsibilities. This structure responds to the variety of opportunities to improve industrial energy efficiency (Figure 1-q).

The ITP organization is designed to achieve ITP and EERE missions, operate efficiently within the EERE organization, and encourage dynamic staff interaction. Our Headquarters organization in Washington, DC is responsible for developing, managing, and evaluating technology portfolios that best achieve ITP goals and strategies. The Golden Field Office and National Energy Technology Laboratory are responsible for initiating, managing, and monitoring all ITP projects. Additionally, they are responsible for delivering technologies to our many partners.

ITP strives to operate under the following principles:

- Foster an environment where individual initiative and accomplishments are valued in a team setting.
- Allocate resources to those technologies that offer the best investment relative to the potential energy savings.
- Use competitive solicitations to select and support proposals that offer the most technically and commercially feasible solutions.
- Contribute to the value and balance of the overall EERE portfolio by supporting industrial R&D, validation, and dissemination activities.
- Provide strategic leadership and program management from EERE headquarters, and rely on field Project Managers to oversee individual projects.

- Seek opportunities to work with all other EERE programs to collectively contribute to the success of the entire EERE team.
- Serve as good stewards of public resources appropriated to carry out the mission.
- Engage industry, states, national laboratories, universities, other federal agencies, and other nations to jointly achieve the EERE and ITP missions, and leverage resources for mutual benefit.

Figure 1-q. Industrial Energy Use and Opportunities

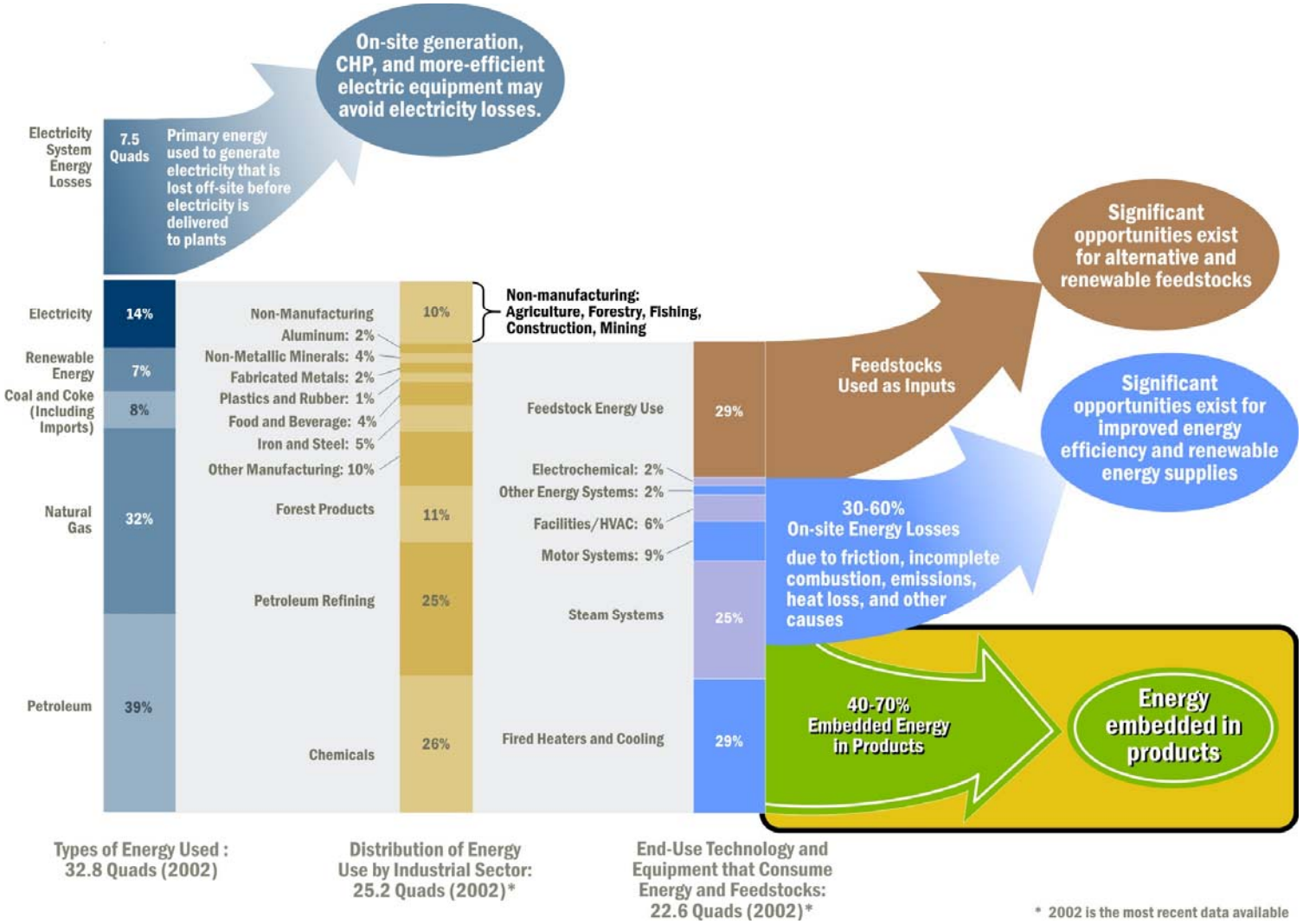
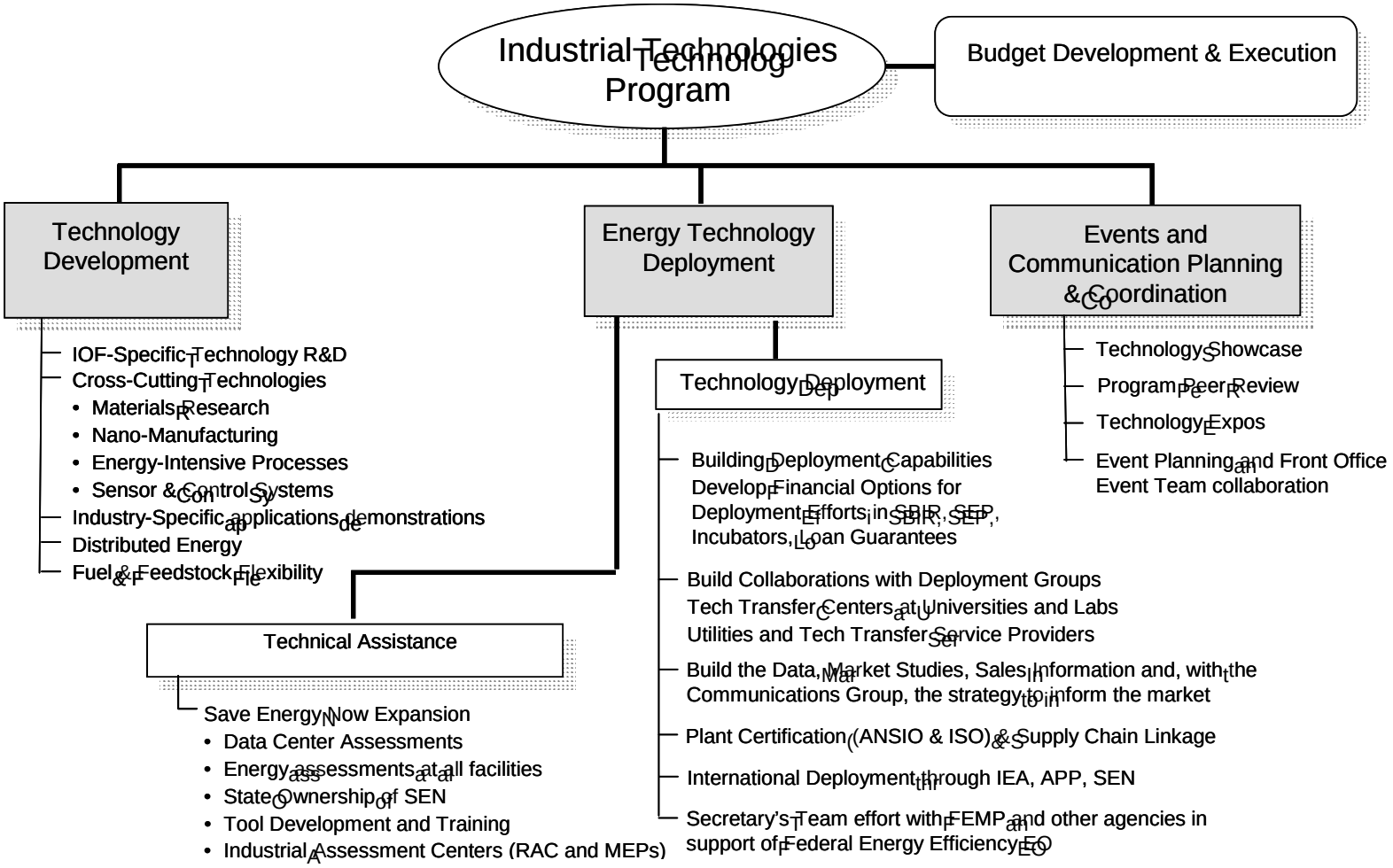


Figure 1-r. ITP Organization Chart



1.4.2 Program Logic

ITP's logic model is displayed in Figure 1-s.

The Industrial Technologies Program has evolved over time into a well-managed and effective program. Its strategy is consistent with higher-level plans of the nation and the Department of Energy, and its management and decision-making processes are solidly based. The program's scope and depth of analysis and reporting are impressive. The ITP significantly leverages its resources through a large and growing number of partnerships with industry, industry associations, and academic institutions. Project portfolios are in place to achieve subprogram goals and, presumably, overall program goals. Current ITP leadership is strong, and the enthusiasm, dedication, and knowledge of subprogram managers are noteworthy. As an overall assessment, it is clear that the ITP team works well together and that a working environment has been established that has made and will continue to make the subprograms succeed.

ITP's STRATEGIC ELEMENTS		
Promote a corporate culture of efficiency in industry	Develop real world energy solutions for industry	Expand the use of proven technologies
Serve as the Federal resource for industrial energy and carbon management • Shape the direction of the industrial market • Foster voluntary corporate commitments to reduce industrial energy intensity • Encourage energy efficiency up and down supply chains • Foster third-party certification for plant energy efficiency • Provide energy analysis and management resources Help Federal agencies reduce energy intensity and carbon emissions	Conduct energy efficiency R&D • Develop advanced technologies for energy-intensive industries • Meet the energy technology needs of a broad manufacturing base • Turn scientific discoveries into next-generation solutions • Investigate industrial carbon reduction strategies Promote fuel and feedstock flexibility • Conduct process integration R&D • Support technology analysis and education • Validate technologies Support commercialization of emerging technologies	Help plants access today's technology and management practices • Assessments • Software tools, training, and outreach • Incentives and recognition • Activities to address market barriers Foster strategic partnerships to expand investment, innovation, and outreach

1.4.3 Relationship to Other Federal Programs

In carrying out the program's mission, Industrial Technologies Program (ITP) performs the following collaborative activities:

- ITP works with DOE's Basic Energy Sciences Program to coordinate research in areas such as nanotechnology.
- ITP coordinates with other Federal agencies, including the National Aeronautics and Space Administration, the National Science Foundation, the National Institute of Standards and Technology, EPA, and the Departments of Defense, Commerce, Agriculture, and Interior to organize research efforts in common areas.
- On manufacturing technology issues, ITP collaborates through the National Science and Technology Council inter-agency working group on manufacturing (IWG) with many of the participating agencies.

There are many examples of projects where ITP has worked with other government programs; examples of ITP's collaboration with other EERE programs are described in Section 1.1.6.

ITP Logic Model

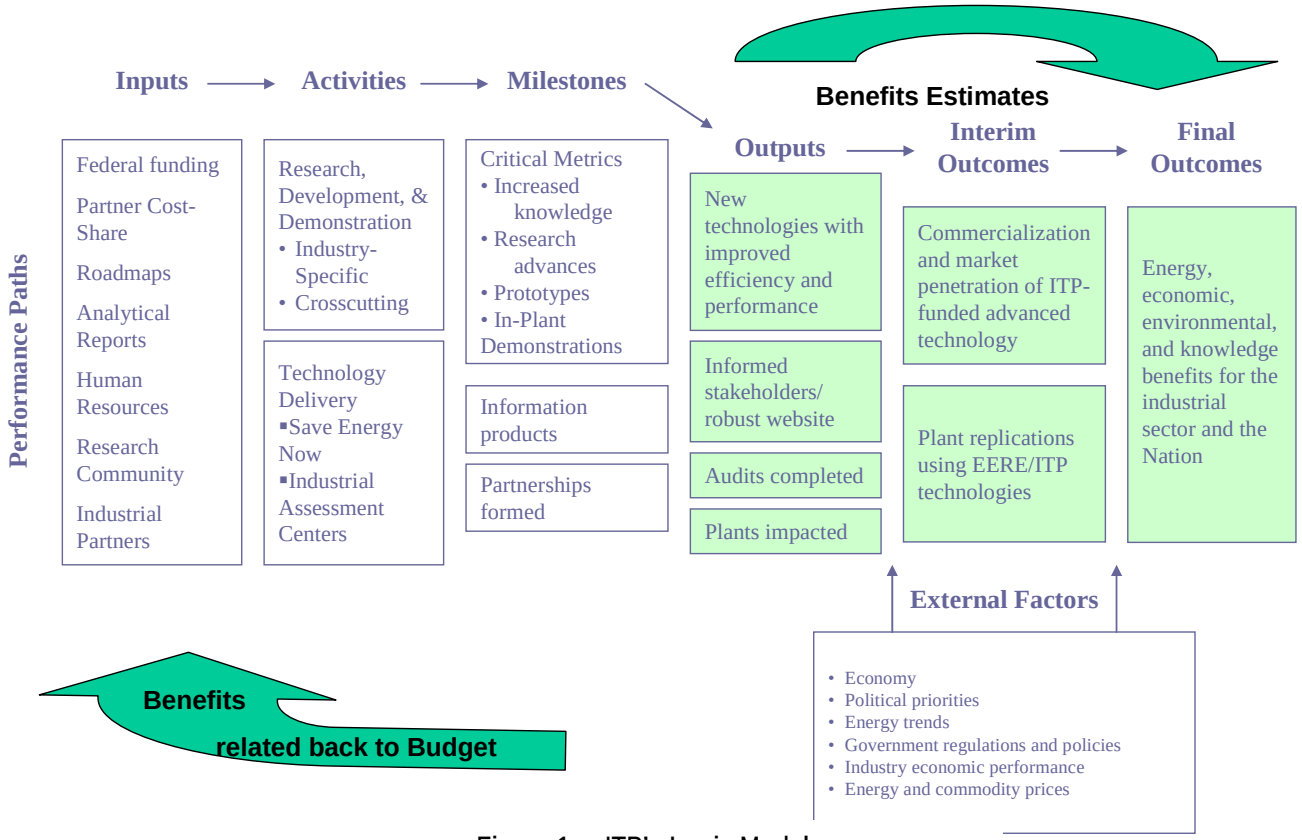


Figure 1-s. ITP's Logic Model

1.5 Program Goals and Multiyear Targets

1.5.1 Goal Cascade

1.5.2 Program Strategic Goals

ITP seeks to reduce the energy and carbon intensity of the U.S. industrial sector through a balanced portfolio of collaborative technology investments, validation, and dissemination of information on energy-efficiency technologies and best energy management and operating practices that are used and replicated. This reduction in energy intensity reduces carbon emissions and improves national energy security, climate and environment, and economic competitiveness. Program objectives are to:

- Provide national leadership in energy efficiency through collaborative R&D and best energy management practices
- Promote the use of proven energy management methods and advanced technologies throughout industry
- Spur national investment in energy efficiency through strategic partnerships with states, utilities, business, the financial community, and others

ITP maintains its position on the cutting edge of new technologies for industry. We continue to work with our traditional industry partners, while identifying game-changing new industries where we can impact efficiency at the ground level. We are also expanding our reach to even more companies through a robust network of state energy offices, utility companies, industry associations, and non-governmental organizations who have a stake in industrial energy efficiency.

Our partnership with industry is taking a giant leap forward in FY08 with the launch of a voluntary program to reduce energy intensity. ITP has established an ambitious goal to help lower the energy intensity of U.S. industry 25% by 2017 in accord with the *Energy Policy Act of 2005*. Industrial companies will voluntarily pledge to meet this goal; ITP will support them by delivering resources to help boost their energy efficiency—whatever their current level of energy performance.

1.5.3 Program Performance Goals

Our R&D and Technology Delivery activities are designed to help industry achieve the goal of a 25% reduction in energy intensity by 2017, as well as a similar decrease in carbon intensity. Our priorities include accelerating the deployment of emerging technologies such as the ultra-efficient superboiler into the market to achieve benefits as quickly as possible – an estimated 300 trillion Btu/year by 2030. Other innovative technologies in the pipeline will be commercialized in the next five years:

- *An alternative ironmaking process* that is 30% less energy intensive (saving 4.7 million Btu/ton of iron produced) than the conventional coke oven/blast furnace route

- *An aluminum melting technology* that reduces melting energy intensity by 70% (saving 2 million Btu/ton of aluminum produced)
- *A high-efficiency pulping process* that is at least 20% less energy-intensive than today's Kraft pulping (saving 2.2 million Btu/ton of pulp produced)
- *A microchannel reactor* for on-site, concentrated hydrogen peroxide production (saving 11 Btu/lb of H_2O_2 produced)
- *A wireless motor monitoring system* to detect poor-performing motors that will save at least $3,000 in energy costs per year for a single 200 hp motor
- *Advanced catalysts* that have 40% higher reaction yields than conventional systems (saving nearly 3,000 Btu/lb of ethylene produced)

ITP's Technology Delivery contributes to the energy intensity reduction goal by giving plants the tools, training, information, and motivation they need to adopt today's more energy-efficient technologies and practices with full confidence in their performance.

1.5.4 Program Multi-Year Targets

Key programmatic outputs and outcomes in the 2008-2012 timeframe are described below.

Programmatic Outputs in 2008-2012 Timeframe

Program outputs are key measures of progress towards reaching program goals.

FY08:

- Commercialize 3 new technologies in partnership with the most energy-intensive industries that improve energy efficiency of an industrial process or product by at least 10%.
- An estimated 100 trillion Btu saved by an additional 800 energy intensive U.S. plants applying EERE technologies and services.

ITP's Activities Will Have a Significant Impact on Industry

In FY08, we will:

- Launch the Save Energy Now Leaders partnership and sign up 60 companies
- Complete 300 Energy Saving Assessments
- Commercialize 3 new technologies
- Achieve annual savings of 100 trillion Btu through Program activities

Over the five-year period FY08-FY13, we will:

- Sign up 240 companies for the Save Energy Now Leaders partnership
- Complete 1,500 Energy Savings Assessments
- Launch ANSI-accredited plant energy-efficiency certification process and certify 1,500 plants
- Commercialize 15 new technologies
- Achieve cumulative 5-year savings of 500 trillion Btu through Program activities

FY09:

- Commercialize 3 new technologies in partnership with the most energy-intensive industries that improve energy efficiency of an industrial process or product by at least 10%.
- An estimated 100 trillion Btu saved by an additional 600 energy intensive U.S. plants applying EERE technologies and services.

Key outputs for FY10-FY12 have not been determined at this time.

Key FY08-FY12 technical milestones for potential technologies that will help meet program goals are included in Section 2.

Programmatic Outcomes in 2008-2012 Timeframe

Programmatic outcomes are key indicators of realizing the program vision.

FY08:

- Annual energy savings from ITP activities in partnership with industry: 180 trillion Btu
- Annual energy savings from ITP technical assistance activities: 200 trillion Btu
- Energy intensity change from 2002: -7.2%

FY09:

- Annual energy savings from ITP activities in partnership with industry: 180 trillion Btu
- Annual energy savings from ITP technical assistance activities: 200 trillion Btu
- Energy intensity change from 2002: -8.3%

Key outcomes for FY10-FY12 have not been determined at this time.